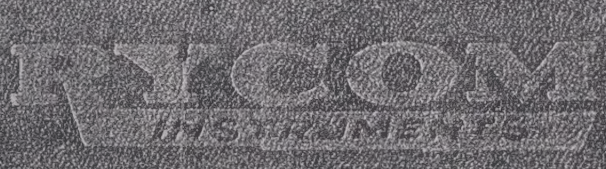
MODEL 2173B

SELECTIVE VOLTMETER



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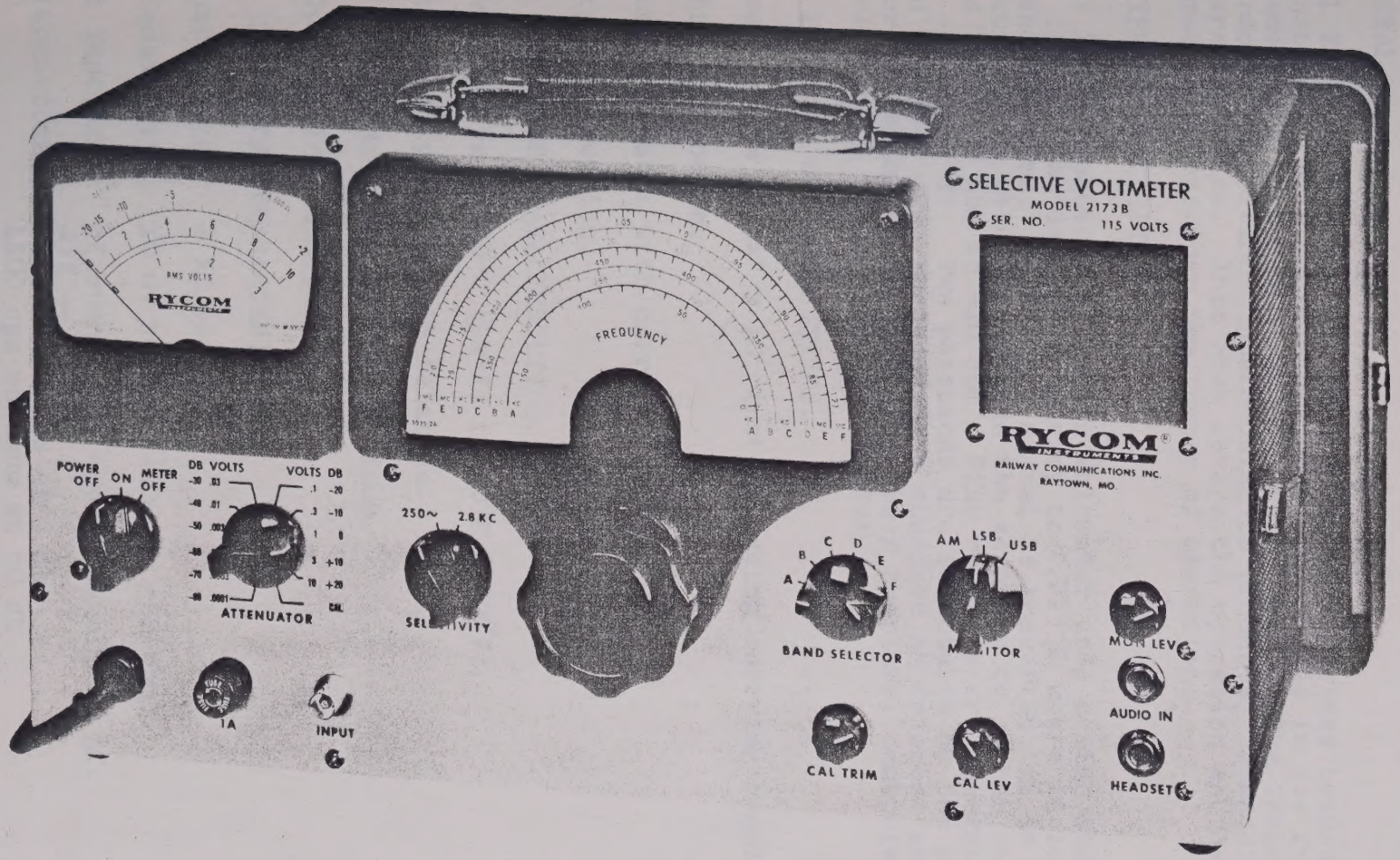

SELECTIVE VOLTMETER
MODEL 2173B
SER. NO.
115 VOLTS
RYCOM
INSTRUMENTS
RAILWAY COMMUNICATIONS INC.
RAYTOWN, MO.
RMS VOLTS
FREQUENCY
POWER OFF ON METER OFF
DB VOLTS
VOLTS DB
ATTENUATOR
250~ 2.8 KC
SELECTIVITY
BAND SELECTOR
AM LSB USB
MONITOR
MON LEV
AUDIO IN
HEADSET
CAL TRIM
CAL LEV
1A
INPUT

1. GENERAL DESCRIPTION.

1.1 GENERAL.

YCOM Model 2173B Frequency Selective Voltmeter operates between 2 KC and 2 C. The instrument will measure discreet frequencies in its frequency range nd also demodulate AM and SSB signals in the range. The instrument will easure harmonic distortion, intermodulation products, crosstalk and trans- ission characteristics. This book covers the operation and maintenance of he instrument and describes the theory of operation.

1.2 EQUIPMENT DESCRIPTION.

YCOM Model 2173B Frequency Selective Voltmeter uses a high side mixer in- ection to convert the desired frequency to 2.215 MC where it is filtered, mplified and detected. Before the signal is converted, it is fed through a recision attenuator which determines the sensitivity of the instrument in 0 db steps from -80 dbm to +20 dbm. Fine readings are determined by the eter from -20 to +2 db. Two passbands are selectable on the instrument: 50 cps and 2.8 KC. Also included is a standard AM detector and a linear SB detector. The instrument includes power supplies, controls, audio am- lifier, calibration circuits and a speaker.

1.2.1 PHYSICAL CHARACTERISTICS.

Size: 17" x 8-3/4" x 10" (not including carrying handle).

Weight: 28 pounds.

onstruction: Portable with carrying handle.

Cooling: Convection.

1.2.2 OPERATING CHARACTERISTICS.

mbient Temperature: -10°C (14°F) to 50°C (122°F).

Ambient Humidity: 0 to 95% relative.

Altitude: 10,000 feet maximum.

erating Duty Cycle: Continuous.

1.2.3 ELECTRICAL CHARACTERISTICS.

Frequency Range: 2 KC to 2 MC.

Input Sensitivity: 10 uv to 10v (-100 to +22 dbm).

Input Impedance: 6K shunted by approximately 20 pf.

Selectivities: 200 to 250 cps at 3 db.
1500 cps maximum at 60 db.

2.3 to 2.8 KC at 3 db.
13 KC maximum at 60 db.

Frequency Stability:	±100 cps after warm up in constant environment.
Accuracy:	±1 db after calibration.
Calibration Accuracy:	±0.1 db at 100 KC.
Power Input:	104 to 126V AC. 50 to 60 cps. approximately 45 watts.
Types of Detection:	AM, LSB and USB.
armonic Response and Distortion Products:	Less than 60 db referred to a 0 db setting on meter.

I. OPERATION.

2.1 INSPECTION.

his instrument has been thoroughly tested and inspected before shipment. t should be inspected for damage as soon as received. If no damage is pparent, proceed to 2.2 Initial Adjustments.

2.2 INITIAL ADJUSTMENTS.

fter the instrument has been unpacked and inspected, plug into the proper 15V AC receptacle and allow unit to warm up. After the instrument has armed up, perform the following tests.

a. Calibrate unit as described in 2.4.

b. With unit still in CALIBRATE, switch MONITOR to LSB and advance ONITOR LEVEL until an audible tone is heard.

c. Switch MONITOR to USB, tone should remain at approximately the same requency and level.

d. Switch MONITOR to AM. Tone will stop and noise will be audible.

e. Adjust main tuning until reading on meter becomes -15 db. Switch ELECTIVITY from 250 cps to 2.8 KC. Reading on meter should be above 0 db.

2.3 CONTROLS.

is section lists and describes the function of all front panel controls.

WER-METER switch S4. Applies primary power to instrument and places short ross the meter in "Meter Off" position.

TENUATOR. Adjusts input level to front end of unit in 10 db steps from 0 dbm to +20 dbm. Calibrate position turns on calibrate oscillator and eds calibrate signal of 100 KC into front end.

LECTIVITY switch S2. 250 cps (for measurements) or 2.8 KC (for monitor-g) IF bandwidths.

uning capacitor C54. Selects frequency to be measured in conjunction
ith band selector by varying main tuning capacitor.

AND SELECTOR switch S3. Selects frequency band for instrument to operate.
ive positions.

ONITOR switch S5. Turns on product detector, feeds proper audio into audio
mplifier and chooses proper SSB crystal.

ON LEV (monitor level) control R103. Adjusts amount of drive to audio am-
lifier.

AL TRIM (calibrate trimmer) capacitor C53. Used to set frequency on cali-
ration points or as a fine tuning adjustment.

AL LEV (calibrate level) control R102. Used to set IF gain in level cali-
rate procedure.

2.4 CALIBRATE PROCEDURE.

he following procedure will calibrate the instrument for level and freq-
ency.

he procedure is performed at 100 KC, the fundamental frequency of the cry-
al calibrate circuit. Other frequency check points every 100 KC to ap-
roximately 1 MC are available by using the harmonics of the crystal cali-
rator.

a. Preliminary setting:

TENUATOR - CAL position.
OWER-METER - ON.
ELECTIVITY - 250 ~ .
NING - exactly 100 KC.
ND SELECTOR - A.

b. Procedure:

just CAL TRIM for maximum meter indication.
just CAL LEV for exactly 0 db on top meter scale.
e unit is now calibrated in volts at the input or in dbm into 600 ohms.

2.5 MEASUREMENTS.

l measurements are made with the selectivity in the 250 cps position. To
arch for a signal it is at times easier to use the 2.8 KC selectivity and
en switch to 250 cps for measurements.

2.5.1 SELECTIVE VOLTMETER MEASUREMENTS.

a. Preliminary setting:

WER-METER - ON.
TENUATOR - lowest level to be measured.
LECTIVITY - 250 ~ .
librate instrument as described in Section 2.4.

b. Procedure:

ine frequency range of interest by using TUNING and BAND SELECTOR. Tune rom low to high frequency. Whenever a signal is found the meter will de- lect. Change ATTENUATOR so that reading is on scale. Note frequency and evel. CAUTION: Instrument will overload and generate harmonics and inter- odulation products of signals applied to the input approximately 70 db down. hese should not be mistaken for signals. A test to determine if the indi- ation is a signal or internally generated is to see if it varies linearly ith attenuator setting (internally generated signals will increase 20 db or a 10 db increase in ATTENUATOR setting).

2.5.2 HARMONIC DISTORTION MEASUREMENTS.

armonics distortion is measured by comparing the ratio of the harmonics to he fundamental frequency.

a. Preliminary setting:

alibrate instrument as described in 2.4.

b. Procedure:

sing the procedure described in 2.5.1 measure f_o and the related harmonics. f total harmonic distortion is required, it can be calculated by the fol- owing formula.

$$\text{Distortion in } \% = \sqrt{\frac{V_{f2}^2 + V_{f3}^2 + V_{f4}^2 \ldots + V_{fn}^2}{V_{fo}^2 + V_{f2}^2 + V_{f3}^2 + V_{f4}^2 \ldots + V_{fn}^2}} \times 100$$

alculation of distortion by using only the 2nd and 3rd harmonics gives a ery small error. Also, if the distortion is under 5% the formula can be pproximated.

$$\text{Distortion in } \% \cong \sqrt{\frac{V_{f2}^2 + V_{f3}^2}{V_{fo}^2}} \times 100$$

ote: For measuring distortion products lower than -60 db, a lowpass filter r notch filter should be used to eliminate the fundamental frequency.

2.5.3 INTERMODULATION DISTORTION MEASUREMENTS.

ntermodulation distortion measurements are made by comparing the levels of istortion products to the levels of two equal test tones.

a. Preliminary setting:

alibrate instrument as described in 2.4.

b. Procedure:

ng the procedure described in 2.5.1 measure the fundamental frequencies the distortion products.

Fl and f2 (fundamental frequencies)

nples of intermodulation distortion are:

- fl
+ f2 2nd order products

- f2
- fl 3rd order products

- 2fl
+ 2f2 4th order products

- 2fl
- 2f2 5th order products

normal measurements the 3rd and 5th order distortion products are the ones measured.

2.5.4 CROSSTALK MEASUREMENTS.

sstalk is the undesired coupling of a signal in one pair of wires or cir- to another pair of wires or circuit.

a. Preliminary setting:

brate instrument as described in 2.4.
e one pair of wires or circuit with a signal between 0 dbm and +10 dbm.

b. Procedure:

sure the signal voltage into driven pair. Measure level on pair not being ven. The ratio of the two signals is the crosstalk and can be measured 100 db.

6 DEMODULATION.

RYCOM Model 2173B is equipped with AM and SSB detector and a demodula- bandwidth of approximately 2.8 KC. Three KC AM and SSB signals can emodulated and listened to on the speaker included or on external ear- es.

2.6.1 AM DEMODULATION.

a. Preliminary setting:

R-METER - ON.
CTIVITY - 2.8 KC.
TOR - AM.
LEV - audible noise is heard.
LEV - fully CCW.

b. Procedure:

nd signal by appropriate setting of BAND SELECTOR, tuning and ATTENUATOR.
just ATTENUATOR for a meter reading of -5 db to off scale (if reading is
ss than -5 db use next lower attenuator setting).
just TUNING for best audio.

2.6.2 SSB DEMODULATION.

a. Preliminary setting:

WER-METER - ON.
LECTIVITY - 2.8 KC.
N LEV - audible noise is heard.
L LEV - fully CCW.

b. Procedure:

itch MONITOR to desired demodulation (LSB or USB). Find signal by appropate setting of BAND SELECTOR, tuning and ATTENUATOR. Adjust ATTENUATOR r a meter reading of -8 db to +2 db.
just tuning for best audio.

III. PRINCIPLES OF OPERATION.

3.1 GENERAL.

is section consists of a circuit analysis of the selective voltmeter parleling the block diagram and the schematic. The major portions of the lective voltmeter are:

a. Input Circuit - processes signal to drive mixer.

b. Oscillator Mixer - determines operating frequency.

c. IF Amplifier - determines selectivity and has gain to drive the detors.

d. Detectors - rectifies signal for meter and processes signal for audle observation.

e. Audio amp - drives speaker or headset.

f. Cal oscillator - provides frequency and level reference.

g. Power supply - provides voltages to operate unit.

.2 CIRCUIT DESCRIPTION.

3.2.1 INPUT CIRCUIT.

input circuit consists of four parts--type BNC in receptacle, 100 db enuator, 2.215 MC notch filter and a video amplifier.

input signal is fed into a type BNC receptacle and coupled into the nuator by C1. The attenuator is a voltage divider. The signal is pick-ff by the arm of the attenuator and fed through the 2.215 MC notch filter he grid of V1, the video amplifier. The 2.215 MC notch filter is a par-l tuned T filter which provides approximately 30 db of attenuation to 5 MC and 6 db of attenuation to frequencies above 2.215 MC. The video ifier (V1) is a cathode follower which isolates the local oscillator the input jack and impedance matches the input signal to the mixer (V2). signal is coupled from the cathode of V1 through R2 and C3 into the mixer.

3.2.2 MIXER AND LOCAL OSCILLATOR.

section consists of the mixer (CR3), phase splitter (V7) and local osc-tor (V8).

input signal from V1 is heterodyned (mixed) with the local oscillator al in mixer diodes CR3. The mixer diodes operate as a balanced shunt r and short the signal to ground during half the local oscillator cycle. output of the mixer is direct coupled to the grid of mixer amplifier V2.

phase splitter V7 drives the mixer diodes into conduction during half a l oscillator cycle. Conduction occurs when the signal on the plate of s negative and the signal on the cathode of V7 is positive. The local llator signal level at the junction of the mixer diodes is extremely l because of the matching of the diodes. The drive to the phase split-is obtained from the local oscillator through C35.

local oscillator V8 is of the Hartley type in a ground plate configura-. The frequency of the oscillator within each band is varied by C54. band switch S3 determines the operating band. C53 is used to frequency brate the unit and as a fine adjustment for frequency setting. Capaci-C50 and C51 are temperature compensating and determine the frequency ility of the oscillator and voltmeter.

the selective voltmeter to tune a frequency the following equation ap-s. Local Oscillator = Desired Frequency + 2.215 MC.

3.2.3 IF AMPLIFIER.

section consists of the mixer amplifier, crystal filters and the three tages.

grid of mixer amplifier V2 is direct coupled from the mixer and supplies oximately 20 db of gain to the 2.215 MC converted signal. The output of nixer amplifier V2 is coupled by C4 into the A section of switch S2. S2 cts the input and output of either crystal filter FL2 or FL3 and grounds unused filter. The B section of S2 connects the output of either filter he grid of V3 the first IF amplifier. The major portion of the selec-ty is determined by the crystal filters. The 250 cps filter FL2 is used measuring and the 2.8 KC filter FL3 is used for monitoring. Both the s and outputs of the crystal filters are tuned to give a "flat" pass-response.

e major portion of gain in the selective voltmeter is obtained in the ree IF stages V3, V4 and V5. The gain of these stages is approximately) db. The IF stages are of conventional design and transformer coupled. e first IF stage V3 and the third IF stage V5 are fixed in gain and the oes are sharp cutoff. The second IF stage V4 is variable in gain and is remote cutoff tube. R101 (CAL LEV) adjusts the gain of V4 by changing the ate current. The plate voltage of the third IF V5 is obtained through a vider R18 and R19 to limit its peak output and protect the meter circuit om overload. The secondary of IF transformer T3 is short circuited to event possible interaction with the primary. The output of the third IF age drives the detectors.

3.2.4 DETECTORS.

ls section describes the AM-Meter detector and the SSB detector. (AM = olitude modulation, SSB = single sideband).

single detector diode CR2 drives both the meter and AM audio circuits. The signal is coupled through C27 into the AM-Meter detector CR2. The audio taken from the cathode side of CR2 and feed through a lowpass filter R30 C30 to the monitor switch S5. R51 is a dummy load for the detector when is not being used. The Meter drive is fed through a lowpass filter R31 C31 to the meter. R32 improves the damping characteristics of the meter.

SSB detector V9 is a self-excited electrostatically deflected sheet beam odulator. This type of demodulator has extremely good linearity and AM ection. The self-excited crystal oscillator operates as a pierce oscil- or using the screen of V9 as a plate. The crystal frequencies lie immed- ely above and below the 2.8 KC crystal filter so that either LSB or USB be demodulated. The crystal below the 2.8 KC crystal filter is used to odulate LSB. IF signal from the plate circuit of the third IF is fed ough divider R28 and R29 to one of the deflection plates (pin 9) of V9. demodulated SSB signal is taken from one of the plates (pin 7) of V9. demodulated SSB signal is then fed through lowpass filter R50 and C61 the monitor switch. The monitor switch also determines which crystal the detector will use.

3.2.5 AUDIO AMPLIFIER.

audio amplifier V10 is a single class A transformer output stage which l drive either the speaker or headphones. The plate supply to this stage not regulated. The drive for the audio amplifier is selected by the mon- r switch. The drive level is determined by R103 (monitor level). The put can be monitored by the speaker or with a pair of external head phones.

3.2.6 CALIBRATE OSCILLATOR.

s section is composed of a 100 KC crystal oscillator and a clipper. The illator V6 is a pierce type circuit with the output coupled through R23 C23 into the clipper diode CR1. The clipper is thermally stable but t be set levelwise for each diode. R102 sets the exact level. The out- of the limiter is fed into the attenuator in the CAL position and used calibrate the selective voltmeter for both level and frequency. Level can set only at 100 KC but frequency can be set on 100 KC increments to ap- ximately 1 MC by using the 100 KC harmonics.

3.2.7 POWER SUPPLY

power supply consists of a transformer, rectifier, filter, 150V regula- and 75V regulator.

transformer (T5) output is rectified by selenium bridge rectifier CR4. tering is done by C64b and C64c and L7. The output of the filter is ap- ximately +225V. The +225V is fed through dropping resistor R53 to V11, +150V regulator. The regulated +150V is fed through dropping resistor to CR5 the +75V regulator. Capacitor C65 is a noise suppressor.

Voltage	Operates
225V Non-regulated	Audio Amp and 150V Regulator
150V Regulated	CAL OSC, Video Amp, Mixer Amp, IF Amplifiers, SSB Detector and +75V Regulator
75V Regulated	Local Osc and Phase Splitter
.3V AC	All filaments and dial lights

MAINTENANCE.

.1 REQUIRED TEST EQUIPMENT.

4.1.1 Sweep generator and display with the following characteristics.

quency - any between 40 KC and 1.9 MC.
ep Range - variable between 1 KC and 40 KC.
ep Rate - approximately 2 seconds.
nal Output - any between .1 volts and 10 volts.
play - visual (oscilloscope).

4.1.2 AC vacuum tube voltmeter with a minimum sensitivity of 5 volts l scale and frequency response flat to 2 MC.

4.1.3 Signal Generator or Signal Generators.

quency Range - 1 KC to 2.3 MC.
quency Accuracy - 1 part in 10^5.
put Level - -80 dbm to +20 dbm.
put Level Accuracy - ±.2 db.

ernate: Use separate AC vacuum tube voltmeter to obtain level accuracy. Use separate counter to obtain frequency accuracy.

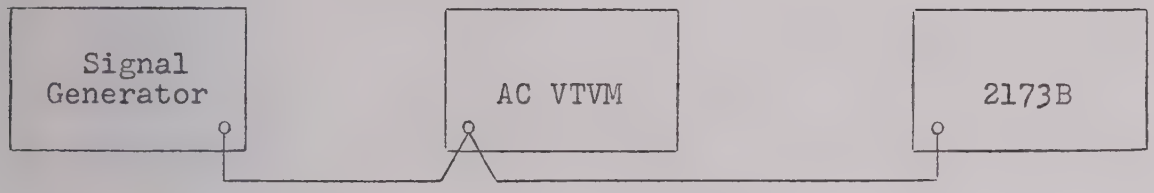
.2 ALIGNMENT.

selective voltmeter is completely aligned at the factory and should not realigned as routine maintenance.

TION: Alignment of the crystal filters and the IF transformer should not be attempted without using a sweep "set up."

4.2.1 Calibrate Oscillator Adjustment.

a. Test Setup:



b. Preliminary settings:

1) Signal Generator.
100 KC at 0 dbm (.776 volts).

2) 2173B Selective Voltmeter.
Selectivity - 250 cps.
Band Selector - A.
Attenuator - 0 db (1 volt).
Power-Meter - ON.
Main Tuning - Exactly 100 KC.

c. Procedure:

1) Tune signal generator for maximum 2173B meter reading.

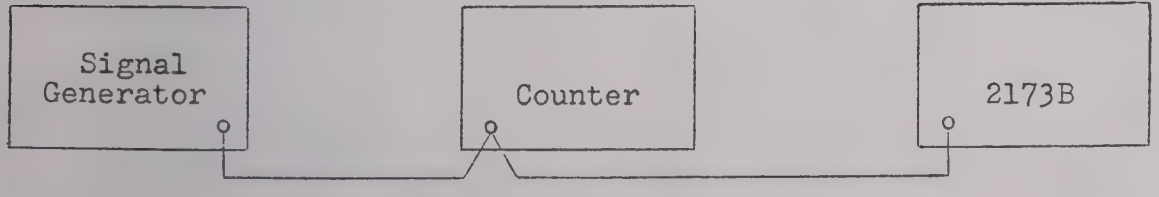
2) Adjust CAL LEV for exact 0 db meter indication.

3) Set ATTENUATOR in CAL position and adjust CAL TRIM for maximum meter reading.

4) Adjust R102 (CAL ADJ) for exact 0 db meter indication.

4.2.2 Local Oscillator Adjustment.

a. Test Setup:



TION: Entire local oscillator adjustment procedure must be performed in sequence.

b. Preliminary settings:

1) Signal Generator.
As listed in c below.

2) 2173B Selective Voltmeter.
Selectivity - 250 cps.
Power-Meter - ON
Cal Trim - capacitor plates half meshed.
Monitor - LSB
Mon Lev - Audible Noise.
Attenuator - compatible with signal generator output.

c. Procedure:

1) Set band selector on band F.
Set signal generator to 1.9 MC.
Set 2173B main tuning to 1.9 MC.
Adjust C49(F) for maximum meter indication.

2) Set signal generator to 1.3 MC.
Set 2173B main tuning to 1.3 MC.
Adjust L6 for maximum meter indication.

3) Set signal generator to 1.9 MC.
Set 2173B main tuning to 1.9 MC.
Adjust C49 for maximum meter indication.

4) Repeat steps 2 and 3 until further adjustment of C49 and L6 does not increase meter reading.

5) Set band selector on band E.
Set signal generator to 1.05 MC.
Set 2173B main tuning to 1.05 MC.
Adjust C47(E) for maximum meter indication.

6) Set Band Selector on band D.
Set signal generator to 700 KC.
Set 2173B main tuning to 700 KC.
Adjust C45(D) for maximum meter indication.

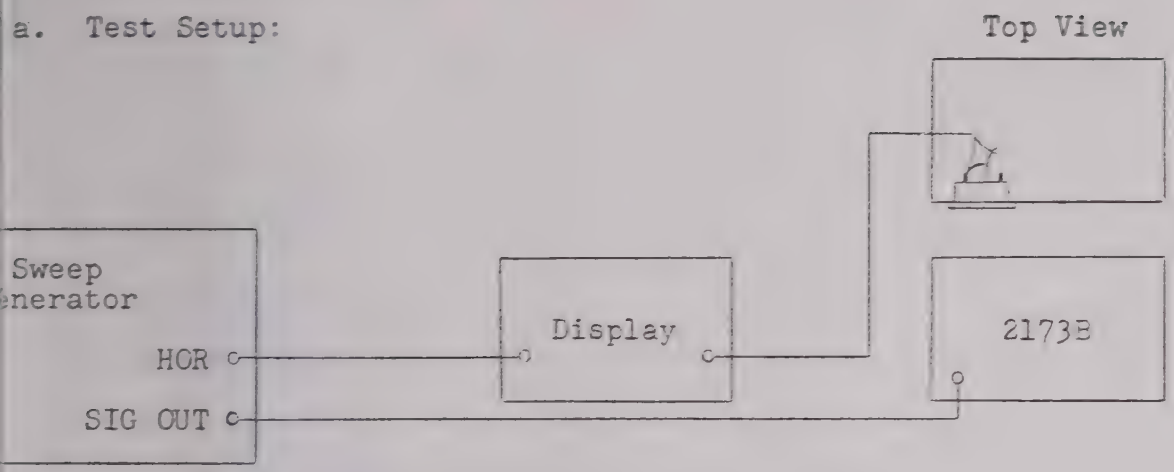
7) Set Band Selector to band C.
Set signal generator to 450 KC.
Set 2173B main tuning to 450 KC.
Adjust C43(C) for maximum meter indication.

8) Set Band Selector to band B.
Set signal generator to 250 KC.
Set 2173B main tuning to 250 KC.
Adjust C41(B) for maximum meter indication.

9) Set Band Selector to band A.
Set signal generator to 100 KC.
Set 2173B main tuning to 100 KC.
Adjust C39(A) for maximum meter indication.

4.2.3 IF Amplifier Adjustment.

a. Test Setup:



b. Preliminary settings:

1) Sweep Generator.
Sweep rate 2 seconds.
Sweep width 40 KC.
Frequency output between 40 KC and 1.9 MC.

2) 2173B Selective Voltmeter.
Remove the inner conductor of the shielded wire from the meter and connect to the vertical of the display.
Place a 27 to 47Ω resistor from the grid (pin 1) of V3 to chassis ground.
Connect a wire from the arm of S2a (SELECTIVITY) to the grid (pin 1) of V3.
SELECTIVITY 250 cps.
ATTENUATOR compatible with the output of the sweep generator.
POWER-METER ON.
CAL LEV fully CCW.

c. Procedure:

1) Adjust the BAND SELECTOR and main tuning until the response appears on the display unit.

2) Adjust T1 (top and bottom), T2 (top and bottom) and T3 (bottom) until the response is flat or slightly dipped around the marker. The marker is caused by the response of the 250 cps crystal filter. CAUTION: The ATTENUATOR must be adjusted so the IF amplifier is not overloaded.

4.2.4 Crystal Filter Adjustment. (Tune IF amplifier before tuning the crystal filters).

a. Test Setup (same as 4.2.3).

b. Preliminary Settings.

1) Sweep Generator.
Sweep rate 2 seconds.
Sweep width - 10 KC for 2.8 KC filter.
1 KC for 250 cps filter.
Frequency output between 40 KC and 1.9 MC.

2) 2173B Selective Voltmeter.
SELECTIVITY - 2.8 KC for 2.8 KC filter.
250 ~ for 250 cps filter.
POWER-METER - ON.
CAL LEVEL - 50% of rotation.
ATTENUATOR - compatible with sweep generator output.

c. Procedure.

1) Adjust the BAND SELECTOR and main tuning until a response appears on the display unit.

2) 2.8 KC filter. Adjust C7 and C9 for a "flat" response.

3) 250 cps filter. Adjust C6 and C8 for a "flat" to "bullet nosed" response.

.3 TROUBLE SHOOTING.

4.3.1 Test Procedure.

s procedure is not to be used to determine if the selective voltmeter unctioning properly. The procedure is a fault localizing procedure should be done in sequence.

Circuits under Test	Procedure
a) IF Amplifier and meter circuit	CAL LEV-CCW Place 27 to 47Ω resistor from grid of V3 (pin 1) to chassis ground. Drive grid of V3 with a 2.215 MC sig. Maximum level for 0 db meter reading 170 uv.
b) SSB Demodulator and Audio Amplifier	CAL LEV - CCW MONITOR - LSB MONITOR LEV - 50% rotation Perform check a) on IF Amplifier and meter circuit. Drive V3 at the level to get 0 db reading on meter. Audio tone should be on speaker.

(Chart continued on next page)

c) Input Circuit and Filters	CAL LEV - CCW Drive the input connector with a 2.215 MC signal and obtain a 0 db reading on meter. The input level should be approximately 30 db up from the ATTENUATOR setting.
d) Local Oscillator or Mixer	If test a,b and c indicate no trouble, the trouble is in the local oscillator, phase splitter or mixer.

4.3.2 Possible Troubles.

Trouble	Cause
a) High noise level at low frequencies	C65 open.
b) High local oscillator leakage at low frequencies	Component trouble with R33, R34, R35, R36, C32, C33, V7 or FL2.
c) Excessive 60, 120 or 180 cps output on SSB monitoring	1. Selective voltmeter is in a high magnetic field and V9, 7360, is being magnetically modulated. 2. Power supply filter trouble.
d) Meter reading does not track	Component trouble with CR2, 1N277.
e) No dial light	Remove frequency tuning knob and cover. Replace defective lamp. NOTE: Spring is loose on shaft, don't lose. See f for knob replacement.
f) Dual speed frequency drive does not function	Adjust spring tension on knob. Depress knob and tighten set screw. Check rotation to see that spring has sufficient tension to raise knob, shaft & gear enough to engage speed reduction gear. Check rotation with knob depressed to see if spring will compress enough to engage direct drive.
g) To remove unit from case remove only the screws around the edge of the front panel.	

METER-POWER - ON
CAL LEV - CCW
ATTENUATOR - CAL
MONITOR - LSB
BAND SELECTOR - B

Tube No	Pin No										
	1	2	3	4	5	6	7	8	9	10	12
V1 6CW4	-	67VDC	-	0	-	-	-	1.3VDC	0	0	6.3VAC
V2 6CW4	-	110VDC	-	0	-	-	-	.9VDC	-	0	6.3VAC
V3 6BH6	0	1.9VDC	6.3VAC	0	145VDC	138VDC	0	-	-	-	-
V4 6BJ6	0	11VDC	6.3VAC	0	150VDC	145VDC	0	-	-	-	-
V5 6BH6	0	1.9VDC	6.3VAC	0	100VDC	142VDC	0	-	-	-	-
V6 6CW4	-	90VDC	-	-9.5VDC	-	-	-	.4VDC	-	0	6.3VAC
V7 6CW4	-	70VDC	-	-.1VDC	-	-	-	2.5VDC	-	0	6.3VAC
V8 6CW4	-	73VDC	-	-4.5VDC	-	-	-	.4VDC	-	-	6.3VAC
V9 7360	4VDC	138VDC	-1VDC	0	6.3VAC	65VDC	65VDC	18VDC	18VDC	-	-
V10 6AQ5	-	17VDC	6.3VAC	0	225VDC	230VDC	0	-	-	-	-
V11 0A2	150VDC	0	-	-	150VDC	-	-	-	-	-	-

bol	Part No	Mfg	Description
	2173B-1	L	Attenuator, 100 db 10 steps plus CAL pos
			Cap., .22 uf ±20% 400 WVDC metalized mylar
3			Cap., .47 uf ±10% 200 WVDC metalized mylar
26-28,30			Cap., .001 uf ±20% 500 WVDC disc ceramic
,60,61			
			Cap., 110 pf ±5% 500 WVDC silver mica AR
7,8,9	Style 557	H	Cap., 5-25 pf NPO 350 WVDC variable ceramic
,14,15,			Cap., .01 uf GMV 200 WVDC disc ceramic
,29,31-33			
,55,57,62			
,13,16			Cap., .01 uf GMV 500 WVDC disc ceramic
,19-23,56,			
,67			
,34,66			Cap., .1 uf ±20% 200 WVDC tubular mylar
			Cap., 500 pf ±5% 500 WVDC silver mica
			Cap., 250 pf ±5% 500 WVDC silver mica
,37			Cap., 100 pf ±5% 500 WVDC silver mica
,41,43	Style 503	H	Cap., 4.5-25pf NPO 350 WVDC variable ceramic
,47,49			
,42,44			Cap., 100 pf ±5% 500 WVDC disc ceramic NPO
			Cap., 110 pf ±5% 500 WVDC disc ceramic NPO
			Cap., 22 pf ±5% 500 WVDC disc ceramic N330
			Cap., 155 pf ±5% 200 WVDC disc ceramic N080
			Cap., 47 pf ±5% 500 WVDC disc ceramic NPO
	Spec 4197	B	Cap., 4-10 pf var. air 4 turn
	167-153-10	G	Cap., 12-150pf variable air
			Cap., 200 pf ±5% 500 WVDC silver mica
			Cap., 22 pf ±5% 500 WVDC silver mica
			Cap., 40-40-20 uf 450-450-25 WVDC electrolytic
			Cap., 5 uf ±20% 100 WVDC metalized mylar
	1N755		Diode, 7.5V, .4 watt, zener
	1N277		Diode, Germanium, signal
	*1N4306		Diode, silicon, signal matched pair
	*61-4037	I	Rectifier, selenium, 100 ma, 240V dc max
	1N1792		Diode, 75V, 1 watt zener
,2	47		Lamp, incandescent, 6.3V, 150 ma
	AGC1		Fuse, 1 amp
	2173B-4	L	Filter, 2.215 MC notch
		E	Filter, 2.215 MC c.f., 250 ~ bw
		E	Filter, 2.215 MC c.f., 2.8 KC bw
	UG1094/U		Receptacle, coax
3	12A	N	Jack
	903PMTH	A	Connector, receptacle electrical
	3047-12	Q	Coil, radio freq 47 uh AR
4	1500-12	Q	Coil, radio freq 500 uh
3	3063-12	Q	Coil, radio freq 63 uh
	2366-3A	L	Coil, radio freq, tapped
	2173B-5	L	Coil, radio freq, slug tuned

bol	Part No	Mfg	Description
	TTI-3133	O	Reactor, 7 hy
	V35A47	P	Loudspeaker 3.2Ω, PM, 3½"
	46-4782-0000	C	Meter, 0-200 ua, 2%
			Res., 2.2K ½W ±10% carbon
			Res., 2.7K ½W ±10% carbon
37,47			Res., 120K ½W ±10% carbon
30,43			Res., 10K ½W ±10% carbon
,50			
10,15			Res., 6.8K ½W ±10% carbon
			Res., 160Ω ½W ±5% carbon
11,12			Res., 1K ½W ±10% carbon
18			Res., 10K ½W ±5% carbon
14,16			Res., 430Ω ½W ±5% carbon
,55			Res., 270K ½W ±10% carbon AR
			Res., 51K ½W ±5% carbon
			Res., 1.3K ¼W ±1% deposited carbon
			Res., 26.1K ¼W ±1% deposited carbon
			Res., 130Ω ¼W ±1% deposited carbon
			Res., 18K ½W ±10% carbon
			Res., 22K ½W ±10% carbon
			Res., 150Ω ½W ±10% carbon
,39			Res., 270Ω ½W ±10% carbon
			Res., 100K ½W ±10% carbon
,31,44,45			Res., 47K ½W ±10% carbon
			Res., 8.2 ½W ±10% carbon
			Res., 4.7K ½W ±10% carbon
,34			Res., 487Ω ½W ±1% deposited carbon
,36			Res., 1.6K ½W ±5% carbon
			Res., 110Ω ½W ±5% carbon
			Res., 27K ½W ±10% carbon
			Res., 82K ½W ±10% carbon
			Res., 12K ½W ±10% carbon
			Res., 820Ω ½W ±10% carbon
			Res., 240K ½W ±5% carbon
			Res., 820Ω 2W ±10% carbon
			Res., 1.5K 10W ±10% wire wound
			Res., 8.2K 1W ±10% carbon
	JF7539	F	Res., 5K ½W ±30% variable, linear, 3/8"shaft
	NB3153	F	Res., 1.2K ½W ±30% variable, linear, 1/8"shaft
	NB3152	F	Res., 250K 1/8W ±30% variable, audio, 3/8" shaft
	73B-S1	L	Switch, rotary, 3 deck 3 pole, 12 pos
	73B-S2	L	Switch, rotary, 2 deck 2 pole, 2 pos
	73B-S3	L	Switch, rotary, 1 deck 1 pole, 6 pos
	73B-S4	L	Switch, rotary, 1 deck 1 pole, 2 pos with SPST, 3 amp, 125V power switch
,3	R10,000	M	Transformer, 2.215 MC IF
	TTI-3134	O	Transformer, output, 600Ω sec, tapped at 3.2Ω
	TTI-3135	O	Transformer, pwr 115V pri, 230 & 6.3V sec
	74A-S5	L	Switch, rotary, 1 deck 3 pole, 3 pos

bol	Part No	Mfg	Description
2,6	6CW4	K	Electron Tube, triode
8			
5	6BH6		Electron tube, pentode
	6BJ6		Electron tube, pentode
	7360		Electron tube, sheet beam
	6AQ5		Electron tube, pentode
	0A2		Electron tube, 150V regulator
		A	Cord, 3 wire power
	116K	J	Crystal, 100 KC
	157K	J	Crystal, 2213.50 KC
	158K	J	Crystal, 2216.50 KC

List of Manufacturers.

A Alden Products Company
B All Star Products Inc
C Assembly Products Inc
D Belden Mfg Company
E Blackhawk Engineering Company or Midland Mfg Co
F CTS Corporation
G E.F. Johnson Company
H Erie Technological Products Inc
I International Rectifier Corp
J James Knights Company or Electronic Research
K Radio Corporation of America
L RAILWAY COMMUNICATIONS INC
M Stanwyck Winding Company
N Switchcraft Inc
O Transformer Technicians Inc
P Utah Radio Products
Q Wilco Corporation
R Semicon Inc

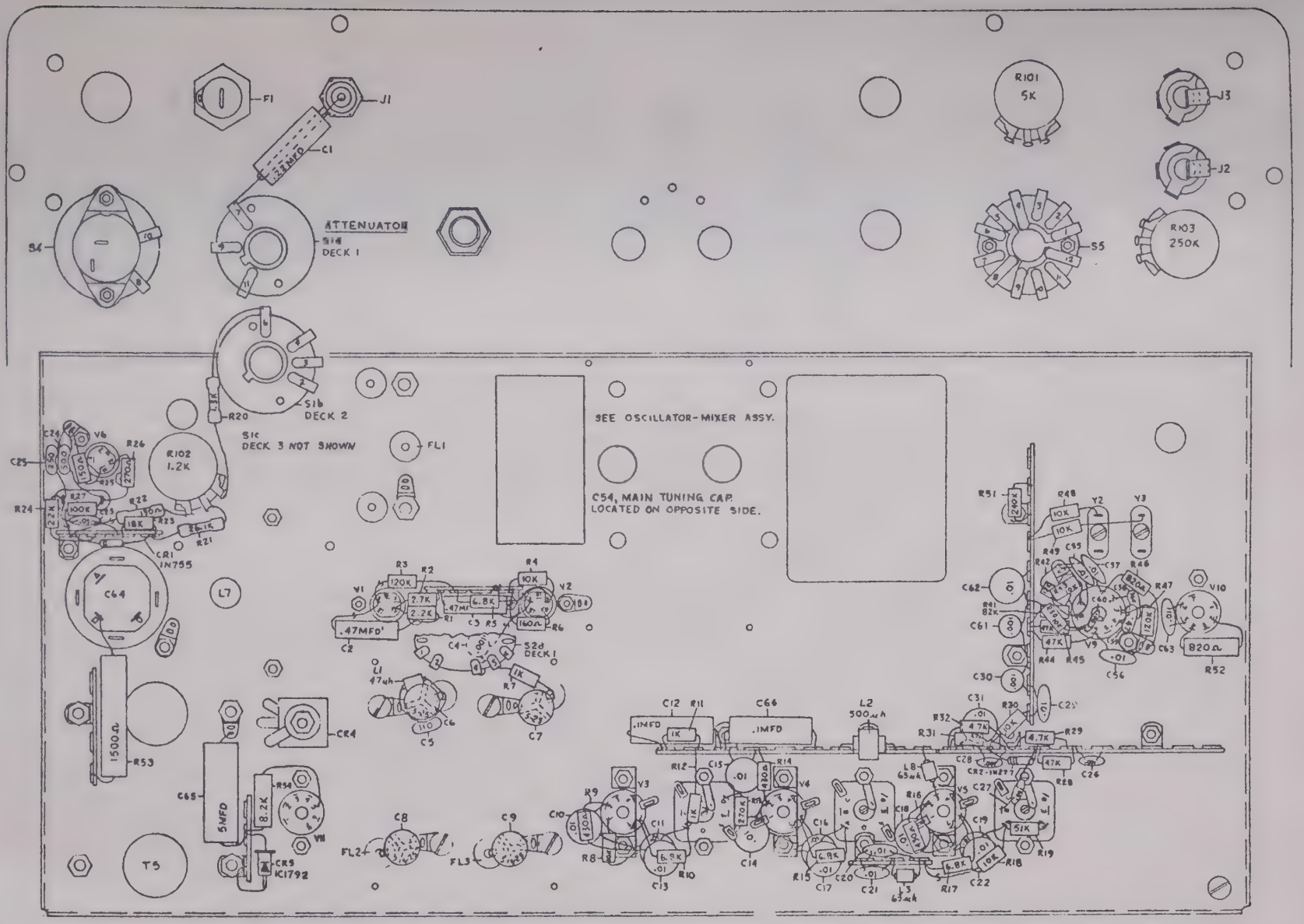
Abbreviations.

GMV Guaranteed min. value.
c.f. Center frequency.
bw Bandwidth.
PM Permanent magnet.
AR Used only as required.

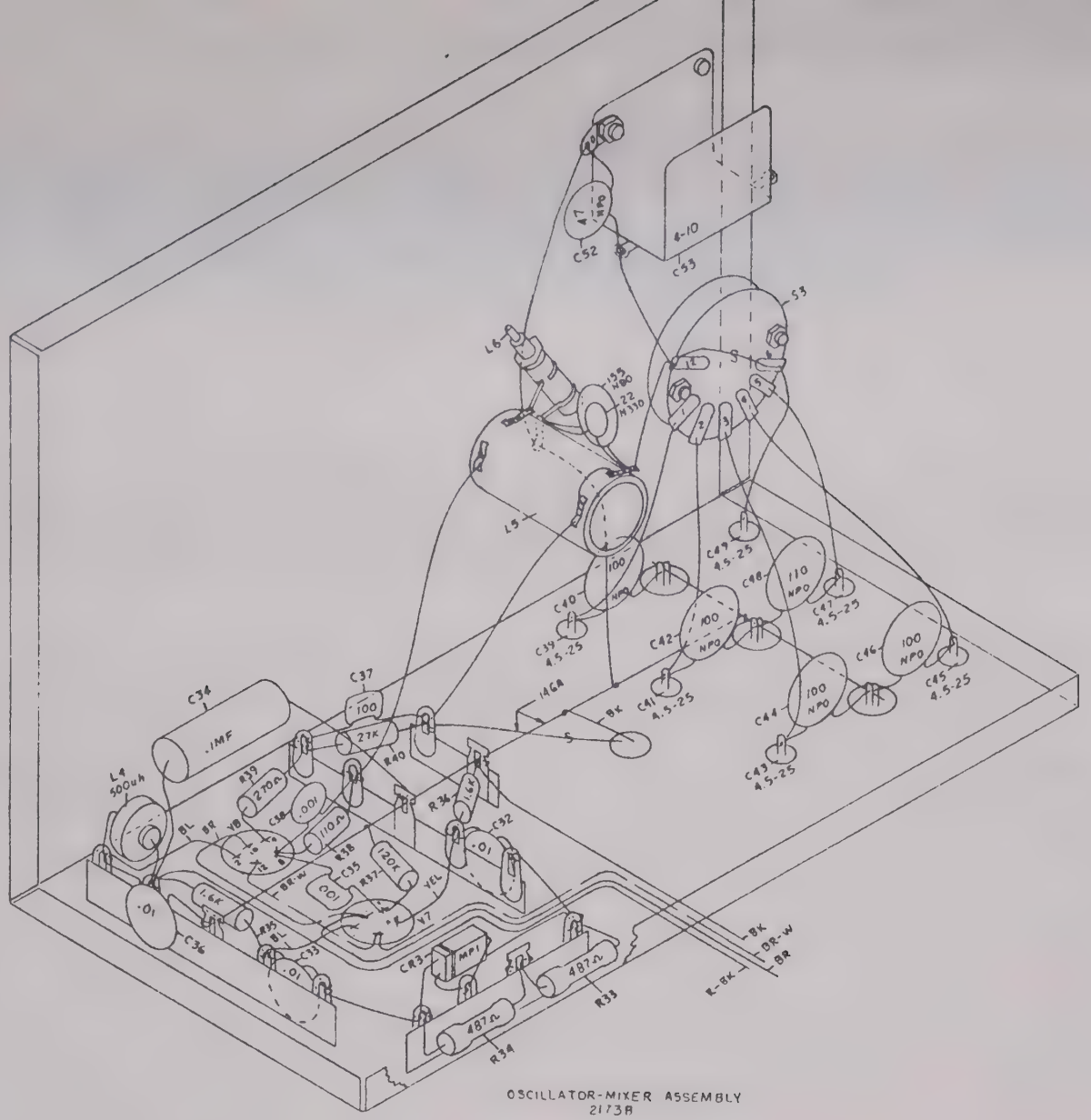
Serial no. 213 thru 314
CR3, as listed (potted assembly)
CR4, as listed

Serial no. 315 up except 431-463

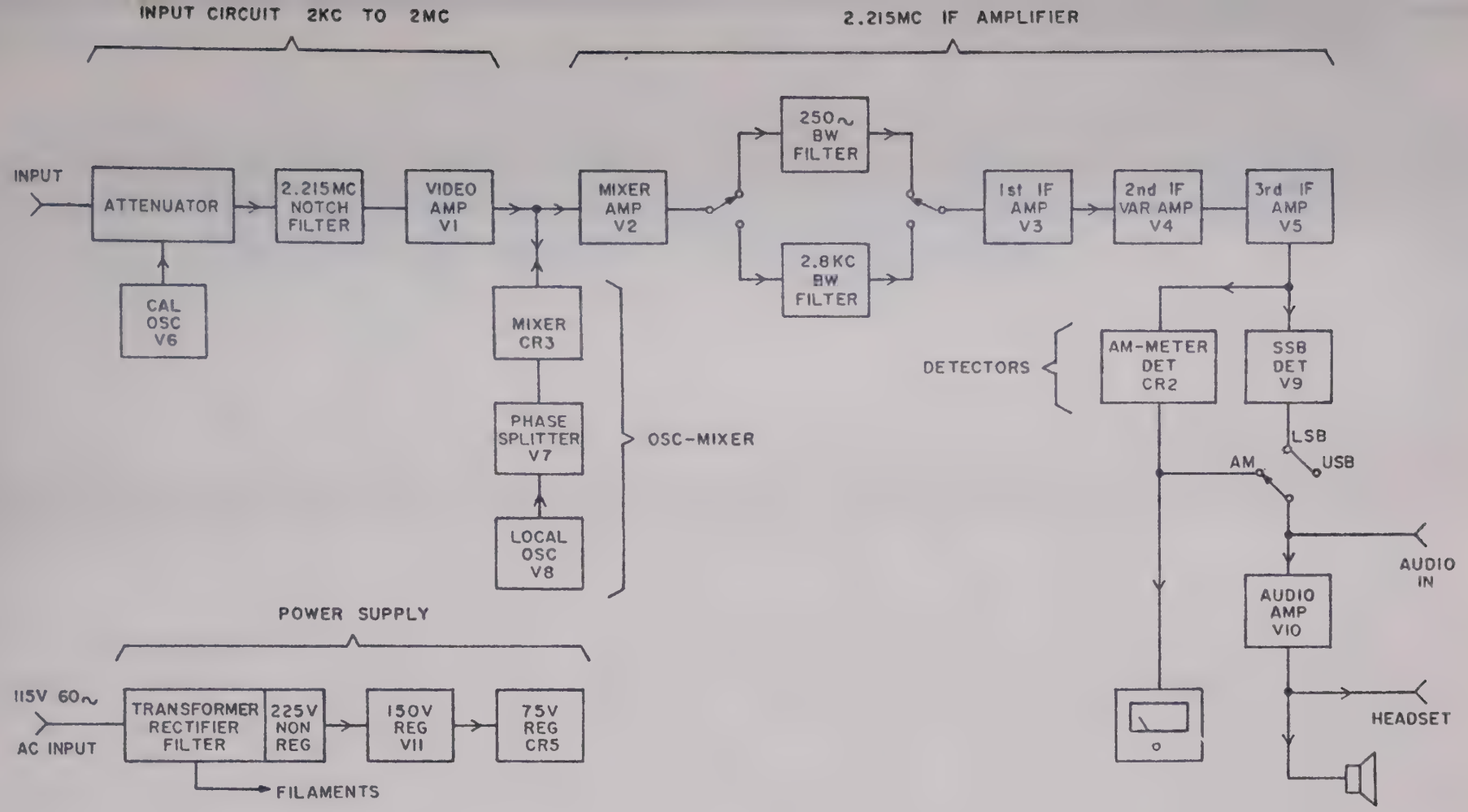
Symbol	Part No	Mfg.	Description
CR3a, CR3b	1N3605		Diode silicon signal, matched pair
CR4,5,6,7	SM180	R	Rectifier, silicon, 850 ma, 800 PIV



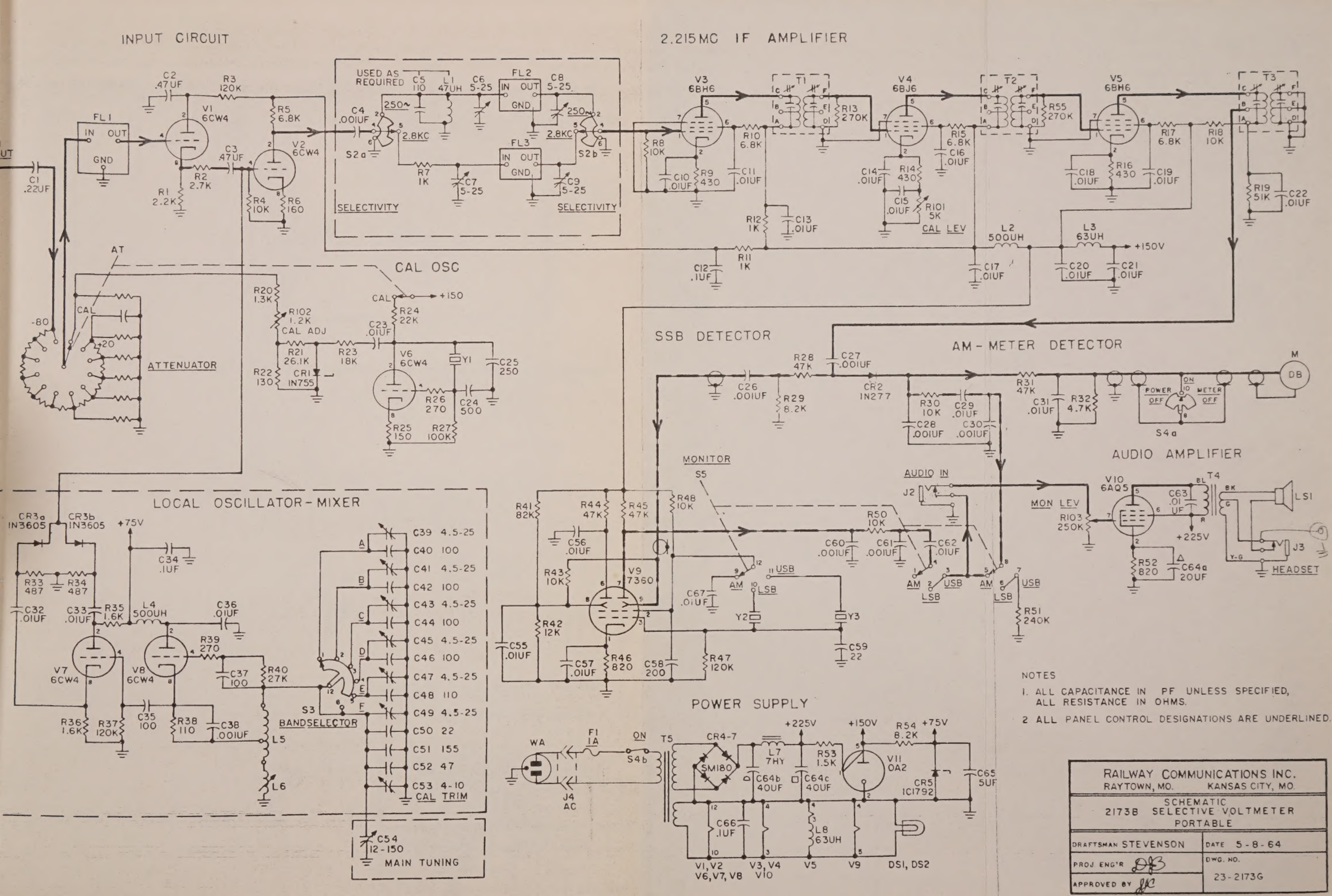
COMPONENT ASSEMBLY
21738

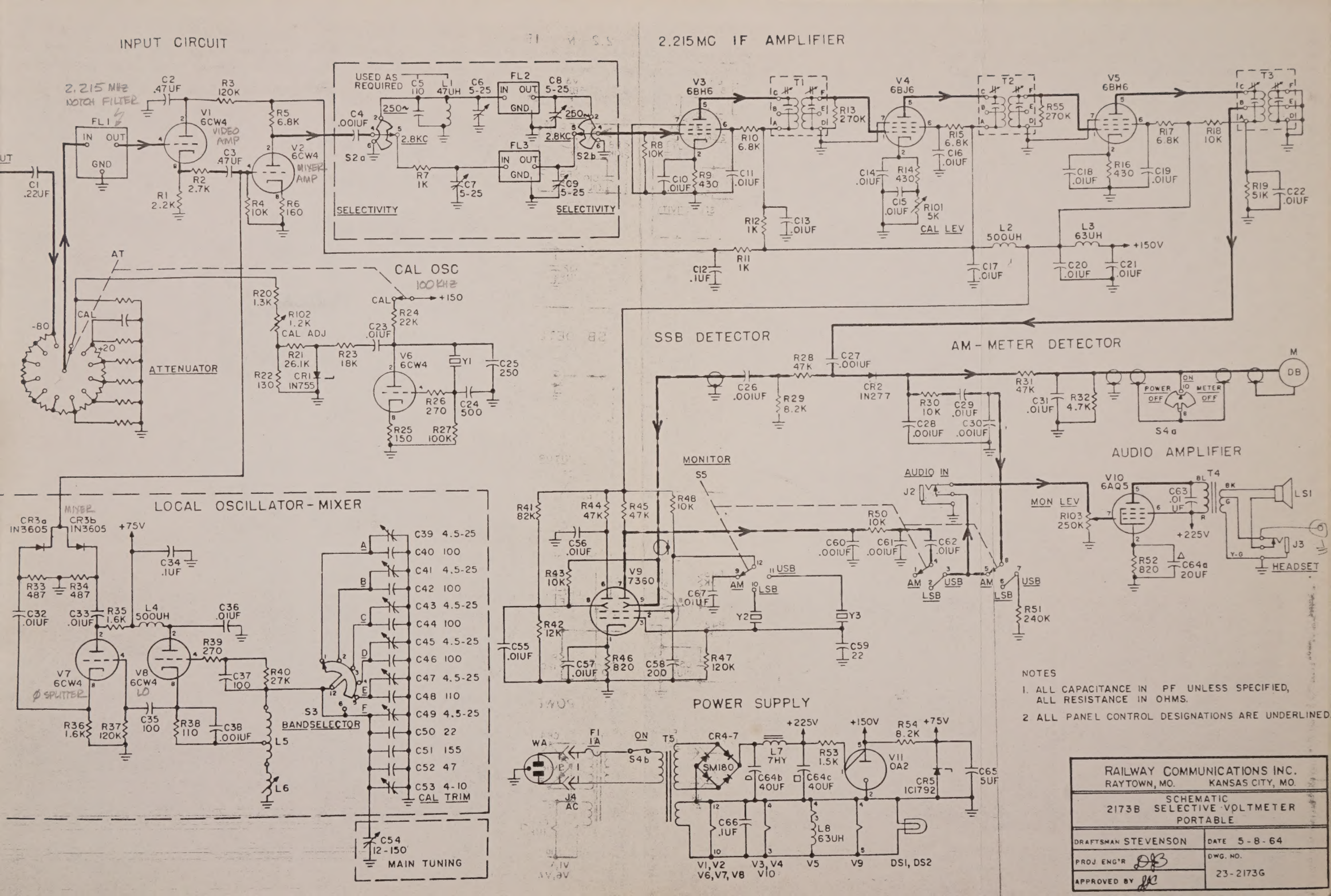


OSCILLATOR-MIXER ASSEMBLY
21738



BLOCK DIAGRAM
2173B


INPUT CIRCUIT
2.215MC IF AMPLIFIER
SSB DETECTOR
AM-METER DETECTOR
AUDIO AMPLIFIER
CAL OSC
ATTENUATOR
LOCAL OSCILLATOR-MIXER
BANDSELECTOR
MAIN TUNING
SELECTIVITY
MONITOR
AUDIO IN
POWER SUPPLY
NOTES
1. ALL CAPACITANCE IN PF UNLESS SPECIFIED, ALL RESISTANCE IN OHMS.
2 ALL PANEL CONTROL DESIGNATIONS ARE UNDERLINED.
RAILWAY COMMUNICATIONS INC.
RAYTOWN, MO. KANSAS CITY, MO.
SCHEMATIC
2173B SELECTIVE VOLTMETER PORTABLE
DRAFTSMAN STEVENSON
DATE 5-8-64
PROJ ENG'R
DWG. NO. 23-2173G
APPROVED BY



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RAILWAY COMMUNICATIONS INC. RAYTOWN, MO. KANSAS CITY, MO.	
SCHEMATIC 2173B SELECTIVE VOLTMETER PORTABLE	
DRAFTSMAN STEVENSON	DATE 5-8-64
PROJ ENG'R DB	DWG. NO. 23-2173G
APPROVED BY	